Review Paper (Solar Pond/Solar Thermal Energy Collector)

Chirag K. Patil[1] Manoj D. Chorghade[2] Dr. Vinod Bhaiswar[3]
[1,2]Final Year Student [2]Professor
[1,2,3]Department of Mechanical Engineering
[1,2,3]G. H. Raisoni Collage of Engineering, Nagpur, India-440016

Abstract— Solar energy has experiencing rapid growth in fast few years due to both technological improvements resulting in reductions of cost and government supportive policies of renewable energy development and utilization. This study analyzes the technical, economic and policy aspects of solar energy development and deployment. While the cost of solar energy has declined rapidly in the recent past, it still remains much higher than the cost of conventional energy technologies. Like other renewable energy technologies, solar energy benefits from fiscal and regulatory incentives and mandates, including tax credits and exemptions, feed in-tariff, preferential interest rates, renewable portfolio standards and voluntary green power programs in many countries. Potential expansion of carbon credit markets also would provide additional incentives to solar energy deployment; however, the scale of incentives provided by the existing carbon market instruments, such as the Clean Development Mechanism of the Kyoto Protocol, is limited. Despite the huge technical potential, development and large-scale, market-driven deployment of solar energy technologies world-wide still has to overcome a number of technical and financial barriers. Unless these barriers are overcomes, maintaining and increasing supplies of electricity from solar energy.

Key words: Solar Energy, Solar Pond

I. INTRODUCTION

A solar pond is a pond or pool containing salt water in it, which is used to collects and stores solar thermal energy. The saltwater naturally forms a vertical salinity gradient also known as a," halocline", in which low-salinity water floats on top of high-salinity water. The layers of salt solution increase in concentration with depth. The solution has a uniformly high salt cocentration below certain depth.

When the sun's rays contact the bottom of a shallow pool, they heat the water adjacent to bottom. When water at the bottom of the pool is heated, it becomes less dense than the cooler water above it, and convection begins. Solar ponds heat water by impeding this convection. Salt is added to the water until the lower layers of water become completely saturated. High-salinity water at the bottom of the pond does not mix readily with the low-salanity water above it, so when the bottom layer of water is heated, convection occurs separately in the bottom and top layers, with only mild mixing between the two. This greatly reduces heat loss, and allows for the high-salinity water to get up to 90 °C while maintaining 30 °C low-salinity water. This hot, salty water can then be pumped away for use in electricity generation, through a turbine or as a source of thermal energy.

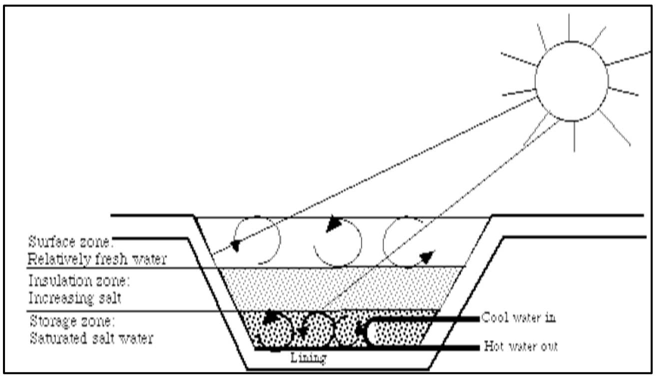

Fig. 1: Solar Pond

II. ADVANTAGES AND DISADVANTAGES OF SOLAR POND

- For rurel areas in developing countries the approach is perticularly attractive. Collector of large area can be set up for just the cost of the clay or plastic pond liner.
- The accumulating salt crystals have to be removed and can be a valuable by-product and a maintenance expense.
- No need for separate collector.
- The extremely-large thermal mass means power is generated night and day.
- Relatively low-temperature operation means solar energy conversion is typically less than 2%.
- Due to evaporation, non-saline water is constantly required to maintain salinity gradients.

III. EFFICIENCY

The energy obtained is in the form of low-grade heat of 70 to 80 °C compared to an assumed 20 °C ambient temperature. According to the second law of thermodynamics (see Carnot-cycle), the maximum theoretical efficiency of a cycle that uses heat from a high temperature reservoir at 80 °C and has a lower temperature of 20 °C is $1-(273+20)/(273+80)=17\%$. By comparison, a power plant's heat engine delivering high-grade heat at 800 °C would have a maximum theoretical limit of 73% for converting heat into useful work (and thus would be forced to divest as little as 27% in waste heat to the cold temperature reservoir at 20 °C). The low efficiency of solar ponds is usually justified with the argument that the 'collector', being just a plastic-lined pond, might potentially result in a large-scale system that is of lower overall levelised energy cost than a solar concentrating system.

IV. DEVELOPMENT

Further research is aimed at addressing the problems, such as the development of membrane ponds. These use a thin permeable membrane to separate the layers without allowing salt to pass through.

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